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APPARATUS AND METHOD FOR PROCESSING VIDEO SIGNAL

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an apparatus and method for processing a video signal. In particular, the invention relates to a video signal processing apparatus such as an electronic still camera or a video camera which has a liquid crystal monitor, and which is operated exclusively by battery driving, and a video signal processing method for use therein.

Related Background Art

A video signal processing apparatus of this sort is described in JP 10-336494 A. An image of a desired object is captured by a solid-state image pickup device and then an image signal representing the object image is converted into digital image data to be recorded in a recording medium such as a memory card. Then, the recorded image data can be arbitrarily read out so that the image represented by the image data can be reproduced on a liquid crystal monitor which is mounted on the apparatus.

As for such a digital camera, there is known one in which an image in a subject area can be enlarged and displayed during reproduction, and JP 10-336494 A discloses a digital camera with a zoom

display function. That is to say, this type of digital camera includes two frame memories: a first frame memory for storing image data of a reproduced image; and a second frame memory for storing a selection frames used to select a subject area. The selection frame is displayed so as to be superimposed on the reproduced image. If a user selects a selection frame of a desired magnification to move the selection frame to a subject area, then the image is enlarged onto the first frame memory by the pixel interpolation method to be displayed on a liquid crystal monitor.

However, in the conventional digital camera, the contents of the frame memory are updated whenever an image is enlarged. Thus, a period of time required for a memory access and an enlargement processing which are caused every time an image is enlarged is felt as a stress by a user who is enlarging an image while checking a state of the magnification. In addition, an excessive electric power is consumed every time an image is enlarged. Moreover, the frame memory is a display memory for the liquid crystal monitor, and hence an image on the frame memory is rougher than that of a captured image. Nevertheless, since in this digital camera, an enlarged image is obtained by enlarging and interpolating a rough image on the frame memory to

construct a new frame memory, an image after determination of the magnification is considerably rough.

In addition thereto, when an image which was enlarged once is to be reduced, it is necessary to newly reconstruct a frame memory through the expansion of the compressed image data of the original image and further enlarge the reconstructed image. In this case, it takes a longer processing time and larger power consumption as compared with the case of enlargement of an image.

SUMMARY OF THE INVENTION

The present invention has been made to solve all of or at least one of the above-mentioned problems associated with the prior art.

It is, therefore, an object of the present invention to provide an apparatus and a method for processing a video signal with which re-size display is carried out following the operation by a user with less power consumption until re-size magnification is determined, and a fine image is displayed after the determination of the magnification.

In order to attain the above-mentioned object, according to an aspect of the present invention, an image display device of the present invention comprising:

first re-size means for reading out image data from a first memory that stores therein image data, and re-sizing the read-out image data;

a second memory for storing therein the image data re-sized by the first re-size means;

display control means for reading out image data from the second memory and re-sizing the read-out image data in accordance with a variable magnification manipulation for an image to make display means display thereon the image of the re-sized image data; and

re-size control means for, while the variable magnification manipulation is carried out, instructing the display control means to make the display means display thereon the image re-sized by the display control means, without newly reading out the image data from the first memory, and after the variable magnification manipulation is fixed, instructing the first re-size means to re-size image data newly read out from the first memory, in accordance with contents of the fixed variable magnification manipulation.

Other objects and features of the present invention will be made clear from the following description of a preferred embodiment and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic block diagram showing a configuration of a video signal processing apparatus according to an embodiment of the present invention;

FIG. 2 is a diagram for explaining a reproduction zooming operation according to the embodiment of the present invention;

FIG. 3 is a diagram for explaining the reproduction zooming operation according to the embodiment of the present invention when magnification is at a limit of original image resolution;

FIG. 4 is a diagram for explaining the reproduction zooming operation according to the embodiment shown in FIG. 1 when magnification is beyond the limit of original image resolution; and

FIG. 5 is a flow chart for explaining the reproduction zooming operation according to the embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A preferred embodiment of the present invention will hereinafter be described in detail with reference to the accompanying drawings.

FIG. 1 is a schematic block diagram showing a configuration of a video signal processing apparatus 100 according to an embodiment of the present

invention.

In the figure, reference numeral 10 denotes an image pickup lens, reference numeral 12 denotes an image pickup element for converting an optical image into an electric signal, and reference numeral 14 denotes an A/D converter for converting an analog signal outputted from the image pickup element 12 into a digital signal. Reference numeral 16 denotes an image processing circuit which serves to subject data outputted from the A/D converter 14 to color carrier removal, aperture correction, gamma correction, and the like to produce a luminance signal and at the same time, serves to subject the data outputted from the A/D converter 14 to color interpolation, matrix conversion, gamma processing, gain adjustment, and the like to produce color difference signals to thereby form image data of a YUV format. Reference numeral 17 denotes a re-size circuit for re-sizing image data into that of a desired size. Reference numeral 18 denotes a memory control circuit for controlling an image display memory area 22 and a memory area 30 of a DRAM 21.

Reference numeral 20 denotes a timing generation circuit for supplying a clock signal and a control signal to each of the image pickup element 12, the A/D converter 14, and a D/A converter 26. The timing generation circuit 20 is controlled by a

system control unit 40.

Reference numeral 24 denotes a re-size display circuit for re-sizing image data in a desired area which is read out from the image display memory area 22, in order to display the desired area on an image display unit 28, reference numeral 26 denotes the D/A converter, and reference numeral 28 designates the image display unit composed of a television monitor or a liquid crystal monitor corresponding thereto.

It is possible to realize an electronic viewfinder from the following procedure. An image signal outputted from the image pickup element 12 is inputted to the image processing circuit 16 through the A/D converter 14 and then image data thereof is re-sized in the re-size circuit 17 if necessary. Then, the image data thus processed is successively inputted to the image display memory area 22 through the memory control circuit 18. Subsequently, the inputted image data is subjected to a re-size display processing in the re-size display circuit 24 as required and is successively displayed an image thereof on the image display unit 28 through the D/A converter 26. However, this embodiment is not limited to this procedure or processing. For example, the image data obtained through the A/D conversion may be temporarily stored in the image display memory area 22, and then the output image data from the

image display memory area 22 may be outputted to the image display unit through the image processing circuit 16, the re-size circuit 17, the re-size display circuit 24, and the D/A converter 28.

Reference numeral 30 denotes a memory area in which image data of a captured image is to be stored. Image data can be exchanged between the memory area 30 and a recording medium 60.

Reference numeral 32 denotes a compression and expansion circuit for compressing and expanding image data through the adaptive discrete cosine transformation (ADCT), the reverse transformation thereof, and the like.

In this embodiment, the image signal outputted from the image pickup element 12 is inputted to the image processing circuit 16 through the A/D converter 14, then is subjected to a re-size processing in the re-size circuit 17 if necessary, and is temporarily stored in the memory area 30 through the memory control circuit 18. Then, after the image data is read out from the memory area 30 and then is compressed in the compression and expansion circuit 32, the image data is stored in the memory area 30 again through the memory control circuit 18 to attain the image pickup and recording of an image. However, the present invention is not intended to be limited to the above-mentioned means. That is to say, the

image data obtained through the A/D conversion may be directly compressed after being image-processed and re-sized. Alternately, the image data obtained through the A/D conversion may be compressed, after being temporarily stored in the memory area 30 and then read out therefrom to be image-processed and re-sized.

In addition, it is possible to realize reproduction of a recorded image through the following procedure: image data of the recorded image is read out from the memory area 30 through the memory control circuit 18 to be expanded in the compression and expansion circuit 32; the image data is then re-sized in the re-size circuit 17 as required; the image data thus processed is inputted to the image display memory area 22 through the memory control circuit 18; the image data is then subjected to a re-size display processing in the re-size display circuit 24 as required; and the image data is displayed on the image display unit through the D/A converter 28. Also, if re-size functions of the re-size circuit 17 and the re-size display circuit 24 are suitably utilized as required, the reproduction zoom can be realized.

Reference numeral 40 denotes the system control unit for controlling the whole video signal processing apparatus 100. The system control unit 40

uses the DRAM 21 as a work area. Also, the system control unit 40 is constituted with a ROM in which a program used to control the video signal processing apparatus 100 and the like are stored, a CPU for executing the program, and the like.

Reference numeral 50 denotes an interface with the recording medium 60 such as a memory card, and reference numeral 52 denotes a connector through which the interface 50 is electrically connected to the recording medium 60 such as a memory card. The recording medium 60 includes a recording unit 62 composed of a semiconductor memory or the like, an interface 64 with the video signal processing apparatus 100, and the connector 66 through which the recording medium 60 is electrically connected to the video signal processing apparatus 100.

Reference numeral 70 denotes an operation unit including a magnification button with which magnification of the reproduction zoom is designated, a position button with which a position is designated, and the like.

A method of realizing the reproduction zoom by this embodiment will hereinbelow be described in detail with reference to FIGS. 2, 3, and 4. In the following description, it is assumed that a size of the recorded image is 1,600 pixels × 1,200 pixels, and the image display unit 28 is constructed in the

form of 752 pixels × 480 lines. However, the combination of a size of the recorded image and the resolution of the image display unit is not intended to be limited thereto, and hence any combination is available.

FIG. 2 shows a case where an image is enlarged from zoom magnification 1. Parts (a - 1) and (a - 2) of FIG. 2 show an operation example when a variable magnification manipulation is carried out to realize the display in a zoom state during setting of the re-size magnification. The part (a - 1) of FIG. 2 shows an image which is obtained by expanding image data of the recorded image in the compression and expansion circuit 32, re-sizing the thus-obtained image data in the re-size circuit 17 so that the image corresponds to an image size of the image display unit 28, and then writing the image data thus processed into the image display memory area 22. When the re-size magnification is not yet determined, an image of a subject area within the image display memory area 22 as shown in the form of a rectangle (indicated by a solid line or a broken line) within the part (a - 1) of FIG. 2 which is designated by the magnification button and the position button is enlarged through the interpolation process to be displayed by the re-size display circuit 24. With this method, the monitor image becomes rough as shown in the part

(a - 2) of FIG. 2. However, since the re-size display can be realized by only changing over a read area, it is possible to attain the reproduction zoom quickly and with less power consumption.

Parts (b - 1), (b - 2,) and (b - 3) of FIG. 2 show an operation example after contents of the variable magnification manipulation are determined, i.e., the re-size magnification is determined. The part (b - 1) of FIG. 2 shows a recorded original image. After image data of the recorded original image is expanded in the compression and expansion circuit 32, the image data of the original image is newly re-sized with a predetermined magnification determined through the variable magnification manipulation in the re-size circuit 17 so that the image becomes of image quality necessary and sufficient for the display resolution of a display device, and then the image data thus processed is written into the image display memory area 22 in a manner as shown in the part (b - 2) of FIG. 2.

While the zoom state during which the variable magnification manipulation is conducted is displayed, an image whose image data is already stored in the image display memory area, is enlarged to be displayed. This stored image to be displayed was subjected to the reduction processing such as thinning-out of the image data, and therefore the

resolution thereof is deteriorated.

At this time, though the displayed image is rough, the display can be speedily carried out all the more since no access to the original image data in the memory 60 is made.

After the variable magnification manipulation is completed to determine the magnification, the display state shown in the part (a - 2) of FIG. 2 is changed over to the display state shown in the part (b - 3) of FIG. 2. In this case, of the image data of the image shown in the part (b - 2) of FIG. 2, the image data in the area designated by the position button is not re-sized. Therefore, enlarged display of an image having high definition can be realized.

When the zoom magnification is not so large, i.e., the final display resolution is lower than the resolution of the original image, the original image is reduced from the image shown in the part (b - 1) of FIG. 2 to the image shown in the part (b - 2) of FIG. 2.

FIG. 3 shows a state in which the zoom magnification is increased up to a level higher than that in the state of FIG. 2 so that the display resolution becomes just equal to the resolution of the original image.

Parts (a - 1) and (a - 2) of FIG. 3 show states of the image display memory area and the monitor in

the middle of carrying out the variable magnification manipulation, respectively. Similarly to the case of FIG. 2, while the zoom state at a time when the variable magnification manipulation is being conducted is displayed, an image whose the image data is already stored in the image display memory area, is enlarged to be displayed. This stored image to be displayed was subjected to the reduction processing such as thinning-out of the image data, and the resolution thereof is deteriorated.

In other words, though the image quality of the displayed image is deteriorated, the image display can be speedily carried out all the more since no access to the original image data in the memory 60 is made.

On the other hand, parts (b - 1) to (b - 3) of FIG. 3 show a state at a time when the variable magnification manipulation is carried out and then the display of a zoom state is carried out during setting of the re-size magnification.

After the recorded original image data is expanded in the compression and expansion circuit 32, the original image data is then newly re-sized with a predetermined magnification determined through the variable power magnification in the re-size circuit 17 so that the image becomes of image quality suitable for the display resolution of a display

device, and the image data thus processed is written into the image display memory area 22 in a manner as shown in the part (b - 2) of FIG. 3.

It should be noted that the re-size processing executed by the re-size circuit 17 when the original image data is inputted to the image display memory becomes unnecessary.

Then, the display state of the part (a - 2) of FIG. 3 is changed over to the display state as shown in the part (b - 3) of FIG. 3. In this case, of the image data in the part (b - 2) of FIG. 3, the image data in the area designated by the position button is not re-sized. Therefore, similarly to FIG. 2, the image having high definition is displayed.

If the zoom magnification is further increased from the state of FIG. 3, i.e., the enlargement rate is increased so that the resolution of the original image becomes lower than that of a display device, the image quality in case of enlargement made by the re-size circuit 17 will become equal to that in case of enlargement made by the re-size display circuit 24. Accordingly, when the magnification is set equal to or larger than that shown in FIG. 3, it is more advantageous to re-size the image by only the re-size display circuit 24 as shown in FIG. 4 in terms of a capacity of the image display memory area 22, and the like. This is because the re-size processing for

image data of the whole image is required for the image display memory, whereas only the image data in the image area intended to be displayed needs to be re-sized in the re-size display circuit. In addition, since an access speed to the memory 60 such as a memory card is generally slower than that to an internal memory, the processing speed is also easy to be increased.

FIG. 5 shows a reproduction zoom processing sequence in this embodiment. When the magnification button is depressed (Step S10), the re-size display circuit 24 re-sizes and displays an image of an area of the image display memory area 22 designated by the magnification button and the position button (Step S14). This operation is continuously carried out until it is detected that the magnification button has become free from its depression to determine the magnification (Step S12). When the magnification button is free from its depression, the re-size circuit 17 re-sizes the original image to reconstruct the image data in the image display memory area 22 (Step S20), and then an area designated by the position button is displayed without the image data therein being re-sized by the re-size display circuit 24 (Step S22). At this time, when the display magnification is not changed (Step S16), a currently stored image data in the image display memory area 22

is used as it is to, display the area designated by the position button without the image data therein being re-sizes for the display (Step S22).

In addition, when the resolution of the enlarged image is beyond a range of the resolution of the original image (Step S18), the image data of the original image is written into the image display memory area 22 with its size being held without being interpolated and enlarged (Step S24), and the re-sizes and display circuit 24 re-sizes and displays the area designated by the magnification button and the position button (Step S26).

As can be readily understood from the above-mentioned description, according to the present invention, since the image display memory area is not reconstructed until the magnification is determined, it is possible to eliminate a processing time and power consumption caused by a memory access and a re-size processing accompanying such reconstruction. After determination of the magnification, since the image display memory area is reconstructed from the original image, a fine enlarged image can be displayed.

It is to be understood that the present invention is not intended to be limited to the above-mentioned embodiment, and hence the various changes will be made without departing from the spirit and

scope of the invention. The scope of the invention is, therefore, to be defined solely by the appended claims.